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**The
White House Conference
on
Child Health and Protection**

November 19-22, 1930

**PRELIMINARY REPORT
OF THE COMMITTEE
ON
THE ECONOMIC ASPECTS OF MILK**

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PRELIMINARY REPORT OF COMMITTEE ON MILK PRODUCTION AND CONTROL

White House Conference on Child Health and Protection ¹

SECTION II: PUBLIC HEALTH SERVICE AND ADMINISTRATION

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¹ Held in Washington, D. C., November, 19-22, 1930.

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PRELIMINARY REPORT

Your committee has directed its efforts toward collecting information on milk that would be of value to the conference in promoting and protecting the health and welfare of the child.

The different phases of milk selected for study were (1) its relation to communicable diseases, (2) its public-health supervision, (3) its nutritional aspect, and (4) its economic aspect. The committee, in order to facilitate its work, was divided into four subcommittees, each of which has considered one of these phases of the subject.

The subcommittee on communicable diseases transmitted through milk collected information on the human and bovine diseases that may be or are milk-borne, the epidemiological evidence of each disease, and the number of recorded outbreaks of disease traced to milk or milk products during the past six years.

The subcommittee on the public-health supervision of milk, obtained information on the essential elements of milk supervision, the legal aspect of its supervision, the measurement of the results of milk supervision effort, and the present status of milk supervision in this country.

The subcommittee on the nutritional aspects of milk considered the nutritive properties of cow's milk and milk products and the nutritive properties of human milk.

The subcommittee on the economic aspects of milk obtained information on the consumption of fluid milk and other milk products, the production, marketing, transportation, processing, and delivery of milk, and the economic importance of the sanitary quality of milk and cream.

For the purposes of this report, each subcommittee has presented a brief statement containing the conclusions it has drawn from its studies and its recommendations based thereon. The individual subcommittee reports follow.

Report of Subcommittee on Communicable Diseases Transmitted Through Milk

The newest and freshest food that we consume in some form every day is at the same time the oldest-known food of which there is an accurate historical record.

Archæologists have recently discovered on the façade of the temple at Ur a milking scene; thus as long ago as 4000 B. C. milk was an important source of food in that ancient civilization of the Chaldees.

The Bible has many references to milk.

The wise King Solomon admonished his people "to have goat's milk for the food of thy household and for the maintenance of thy maidens." No wonder he is represented to be the wisest man in the world!

All down the ages history records the use and importance of milk as a food. Even the legendary tales of ancient Rome recite the most astonishing and magical event of the twin boys, Remus and Romulus, afterwards the founders and heroes of Rome, who, as children, were abandoned in a cave to perish, but who were miraculously nurtured by a "she" wolf with her milk until they were found and rescued.

These actual and legendary records but emphasize the fact of the important place as a food that milk held during all the ages of recorded history.

Babies who were denied mother's milk have been dependent for their nourishment and, indeed, their life, upon milk from some one of our domestic animals, usually the cow, goat, ass, or camel.

The production of an abundant, safe, and wholesome milk supply has been attended with great difficulties and its success or failure has in a large measure conditioned the life hazard of babies who could not be breast fed, as revealed in the infant mortality tables of the various countries of the world, particularly mortality due to the diarrheal diseases. Not only is the life hazard of bottle-fed babies most favorably influenced by a pure and wholesome milk supply, but the average level of robust health of infant, child, and adult as expressed in normal nutrition and vigorous resistance to disease is enormously increased and promoted, for milk and milk products have become one of our most important and indispensable foods in the daily dietary of America.

The tremendous increase in production and consumption of milk and milk products has brought with it problems relating to its safety and wholesomeness.

The recurring milk-borne epidemics, with their annual total of sickness, deaths, and economic loss should be considered in the light of impressive evidence that milk control officials, milk distributors, and dairymen have a tremendous responsibility in securing for the consuming public a clean and safe milk. The evidence that this responsibility has not yet been fully met is presented in the following table of milk-borne epidemics occurring in the United States during the past six years.

TABLE 1.—*Number of milk-borne epidemics in the United States—Cases and deaths by disease and year during the six years 1924–1929*
[Reported by State health officers]

Number of milk-borne epidemics, cases and deaths																										
6 years			1929				1928				1927				1926				1925				1924			
Epidemics	Cases	Deaths	Number of States re- porting	Number of epidemics	Number of cases	Number of deaths	Number of States re- porting	Number of epidemics	Number of cases	Number of deaths	Number of States re- porting	Number of epidemics	Number of cases	Number of deaths	Number of States re- porting	Number of epidemics	Number of cases	Number of deaths	Number of States re- porting	Number of epidemics	Number of cases	Number of deaths	Number of States re- porting	Number of epidemics	Number of cases	Number of deaths
All diseases.....	258	10,906	371	48	1,959	43	48	1,959	44	1,959	43	48	1,959	43	48	1,959	44	1,916	42	32	41	1,374	90	0	0	
Diphtheria.....	8	208	1	0	0	0	1	0	1	0	0	1	0	0	0	2	2	40	1	0	1	23	0	0	0	
Dysentery.....	1	8	0	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gastroenteritis.....	4	301	0	0	0	0	1	0	1	0	2	3	307	0	2	3	307	0	0	0	0	0	0	0	0	
Paratyphoid.....	3	93	1	1	1	1	1	0	1	0	1	1	45	0	1	3	10	0	0	0	0	0	0	0	0	
Poliomyelitis.....	11	2	0	0	38	1	1	0	0	0	1	1	0	0	0	0	1	11	2	0	0	0	0	0	0	
Scarlet fever.....	34	1,974	10	5	722	1	6	8	443	5	3	3	224	0	3	4	205	3	4	5	138	1	4	242	0	
Septic sore throat.....	22	4,161	76	5	739	13	3	1,080	3	1	1	139	3	3	4	1,038	9	5	6	1,085	2	1	1	80	0	
Typhoid fever.....	177	4,019	281	18	450	33	12	18	310	49	15	19	346	31	23	51	1,242	58	10	30	642	36	21	1,029	90	
Undulant fever.....	8	41	0	1	2	0	3	5	32	0	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	

A review of the milk-borne epidemics for 1929, compared with the 5-year period 1924-1928, is not very reassuring from the standpoint of reduction of epidemics and in cases of illness therefrom with their attendant deaths.

Table 2 reveals the situation as reported by the several State health officers of the United States:

TABLE 2.—*Milk-borne epidemics in the United States in 1929—cases and deaths by disease—as compared with those of the preceding 5-year period*

[Reported by State health officers]

Disease	Number of States reporting	Milk-borne epidemics, cases and deaths											
		1929						5-year period, 1924 to 1928					
		Epidemics		Cases		Deaths		Epidemics		Cases		Deaths	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
All diseases	44		1,959		48		214		8,947		323		
Diphtheria	0	0					8	3.73	208	2.32	1	0.30	
Dysentery	1	1	2.27	8	0.41	0	0						
Gastroenteritis	0	0					4	1.86	391	4.37	0	0	
Paratyphoid	1	1	2.27	38	1.93	1	2	2	.93	55	.61	0	0
Poliomyelitis	0	0					1	.46	11	.12	2	.61	
Scarlet fever	5	9	20.45	722	36.85	1	2	25	11.68	1,252	14.00	9	2.78
Septic sore throat	5	7	15.90	739	37.72	13	27.08	15	7.00	3,422	38.24	63	19.50
Typhoid fever	18	25	56.81	450	22.97	33	68.74	152	71.02	3,569	39.89	248	76.78
Undulant fever	1	1	2.27	2	.10	0	0	7	3.27	39	.43	0	0

Table 3 sets forth the sources of milk infection as disclosed by the reports from the State departments of health. Of the 44 epidemics, 13 were traced to chronic carriers of disease; 18 to sick persons continuing to work in the dairy (so-called ambulatory cases); 5 epidemics were reported to be due to contaminated and unsterilized bottles which were returned from homes where sickness prevailed; 4 were said to be due to the polluted water supply; and 1 is attributed to diseased dairy cows. "Carriers" and "cases on dairies," the two most frequent sources of milk infections, combined caused 31 epidemics, or 76 per cent of the total, involving 1,836, or 90 per cent, of the cases and 23, or 51 per cent, of the deaths.

TABLE 3.—*Sources of milk infection in the United States by diseases—Milk-borne epidemics in 1929—Cases and deaths*

[Reported by State health officers]

Disease	Source of milk infection												Total, all sources								
	Unknown			Carrier			Case on dairy			Case on route (re-turned bottles un-sterilized)			Dairy water supply			Dairy cows			Total, all sources		
	Num-ber of epi-cases	Num-ber of deaths	Num-ber of epi-cases	Num-ber of epi-cases	Num-ber of deaths	Num-ber of epi-cases	Num-ber of epi-cases	Num-ber of deaths	Num-ber of epi-cases	Num-ber of epi-cases	Num-ber of deaths	Num-ber of epi-cases	Num-ber of epi-cases	Num-ber of deaths	Num-ber of epi-cases	Num-ber of epi-cases	Num-ber of epi-cases	Num-ber of epi-cases	Num-ber of epi-cases	Num-ber of deaths	
All diseases.....	3	123	3	13	254	11	18	1,391	12	5	142	19	4	47	3	1	2	0	44	1,959	48
Diphtheria.....	—	—	—	—	—	—	8	716	1	1	6	0	—	—	—	—	—	—	9	722	0
Scarlet fever.....	1	100	3	6	639	10	6	36	1	4	136	19	4	47	3	—	—	—	7	739	13
Septic sore throat.....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Typhoid fever.....	1	15	0	12	216	10	4	—	—	—	—	—	—	—	—	1	2	0	25	450	33
Undulant fever.....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
Paratyphoid.....	—	—	—	1	33	1	—	—	—	—	—	—	—	—	—	—	—	—	1	38	1
Dysentery.....	1	8	0	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	8	0

In the fall of 1923 the American Child Health Association, in co-operation with the Conference of State and Provincial Health Authorities and the Association of Dairy, Food, and Drug Officials, inaugurated what was announced at the time as "A nation-wide movement to secure for every baby, child, and adult in America a clean and safe milk supply." This cooperative work has been carried on continuously since its inauguration. Up to 1930, 29 States and one Province of Canada have been surveyed as to the conditions of milk production and distribution in fairly representative sections of the States. The results of these surveys show that the milk supply in the smaller cities and country towns is not generally produced and distributed under such sanitary conditions and safeguards as to insure a safe supply of milk to the ultimate consumer. In these smaller communities a very small percentage of the milk is pasteurized;

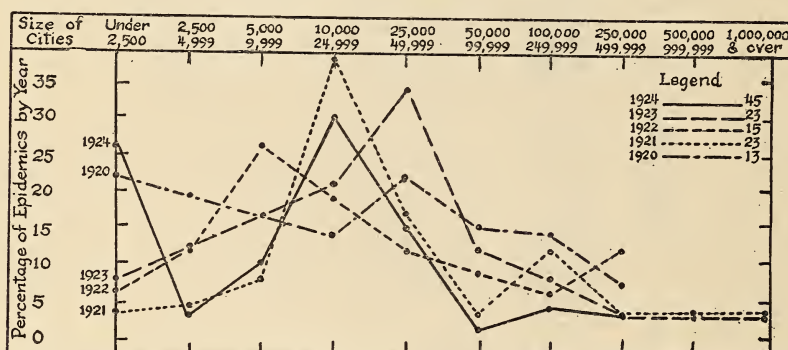


CHART 1.—Milk-borne epidemics in the United States, 1920-1924, reported by State health officers. Of the 119 epidemics recorded on the chart, the major percentage distribution of them occurred in cities of from 10,000 to 25,000 population and in smaller communities, including the rural sections and towns under 2,500 population

thus the continuing annual epidemics of milk-borne diseases need not be a matter of surprise, although it is a matter of great concern from the standpoint of public health. This point of view is supported by the epidemiological evidence shown in Charts 1 and 2.

The probable reason for the higher incidence of milk-borne epidemics in the small country towns and rural sections, and the cities of from 5,000 to 25,000 is that in such communities we find the largest population groups being served almost wholly by raw milk; that is, milk not produced under effective or, in the majority of instances, any source of continuing control. From these studies one may fairly conclude that in the average American city of from 5,000 to 25,000 population, and in the small towns and rural communities one may expect to encounter the greatest health hazard in relation to the consumption of unpasteurized milk.

If we may use milk-supply control as an indication of sanitary development, health department practice in the small town is still

in its infancy. This milk supply is little better in sanitary quality than it would have been if approved processes of pasteurization had never been discovered. The large cities have long recognized the

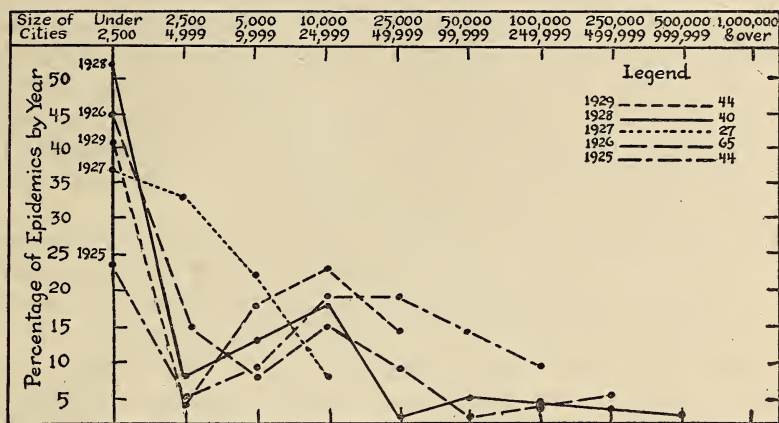


CHART 2.—Milk-borne epidemics in the United States, 1925-1929, reported by State health officers. Epidemics occurring in cities during the period 1925-1929 have somewhat the same distribution as those of the period 1920-1924, although in the later period the larger percentage of milk-borne diseases occurred in the rural districts and in towns under 2,500 population

protection afforded by pasteurization, and thus, so far as milk-borne diseases are concerned, are reasonably well protected. The problem of the small town and city is to awaken its citizens to the need for clean milk, rendered safe by pasteurization. When we remember

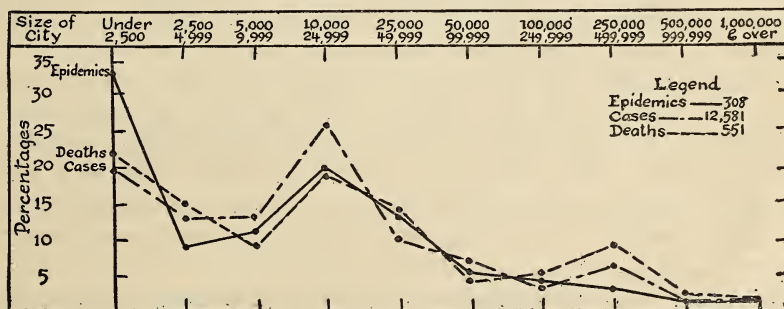


CHART 3.—Milk-borne epidemics in the United States, 1920-1929, reported by State health officers (1920 populations). The percentage distribution of milk-borne epidemics during the decade 1920-1929, as expressed in cases and deaths distributed by population of communities affected, shows the same general trend—the higher percentages occurring in cities of between 5,000 and 25,000 population and in towns under 2,500 population, including rural communities

that approximately 50 per cent of our population resides in the small towns and rural communities, and thus in the main are without the protection that pasteurized milk affords, the importance of this type of public health problem is self-evident.

It seems reasonable to conclude that until the time when we have efficient pasteurization of milk, frequent outbreaks of milk-borne epidemics may be expected.

A search of literature reveals an occasional epidemic of disease caused by dairy products other than milk. Thus there have been recorded five ice-cream epidemics, three of which were outbreaks of typhoid fever, one an outbreak of scarlet fever, and one of septic sore throat. There have been three outbreaks due to infected cheese—one epidemic of typhoid fever, one of streptococcic infection, and one of gastro-intestinal disease. There has been but one outbreak traced to cream, that being a typhoid-fever epidemic.

The same precautions in relation to the protection, manufacture, and distribution of dairy products should be carried out as are necessary in the production and distribution of milk, if we are to be assured of a constantly safe supply of these wholesome dairy products.

A classic illustration, and perhaps the most striking example of the immediate effect in the reduction of diarrheal diseases of infants by the pasteurization of the milk, is that which occurred on Randall's Island, N. Y., in a children's institution, where a mortality of 44.36 was promptly reduced to 19.80 after all the milk was pasteurized, no other hygienic measures being put into operation.

That effective milk supervision and control does greatly reduce that portion of infant mortality due to diarrhea and enteritis is shown by experience in a number of American cities. An excellent example of the apparent correlation between the reduction of fatalities from diarrhea and enteritis and the increase of pasteurization of milk supplies in communities of 10,000 or more is the experience in Massachusetts, which is graphically shown in Chart 4.

It has long been understood, and is being increasingly emphasized, that milk of an insanitary quality or a high bacterial content can not be made into a high grade, wholesome milk through the process of pasteurization. Park and others have shown that milk of a high bacterial content, even when pasteurized, is not a wholesome food for infant feeding. Pasteurization, therefore, is not a substitute for the clean and sanitary production of milk.

However, inasmuch as large numbers of our population living in the smaller cities, towns, and rural communities can not, under present conditions, avail themselves of a wholesome pasteurized milk supply, it becomes all the more necessary that effective sanitary control be instituted in these communities for the production and distribution of a clean and safe milk supply. Perhaps the most promising movement in this direction is the growing demand for the installation and maintenance of full-time county or district health units, through which means a constant and continuing supervision of milk supplies

may be secured. In the absence of local health supervision, the State must assume the responsibility of local milk control.

In some communities milk producers and distributors, recognizing the importance of clean and safe milk, have joined with sympathetic and helpful officials in cooperative effort in the providing of a clean and wholesome supply. Such efforts are commendable and should be fostered wherever possible. The milk-control work in California is an excellent example of such effective teamwork, which has resulted in increased consumption and increased profits for the producers.

Fortunately, purity and cleanliness of milk are the chief requisites in flavor and general wholesomeness, so that the real interests of both milk producers and distributors and the public control officials run

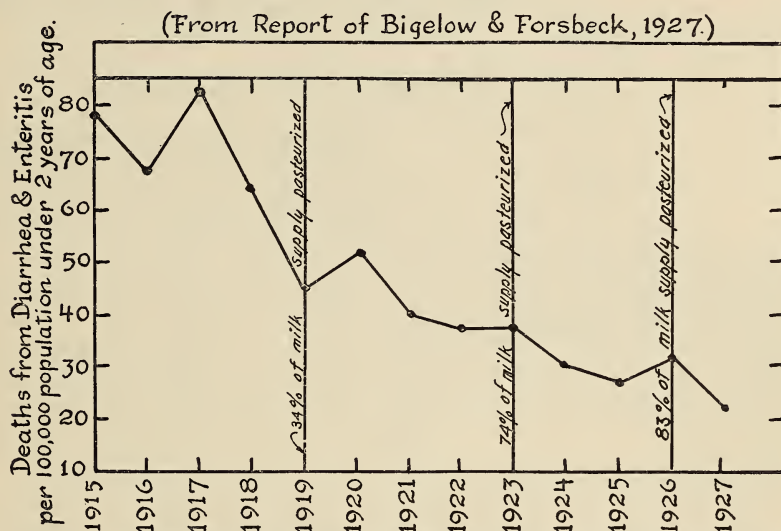


CHART 4.—Correlation between deaths from diarrhea and enteritis and the pasteurization of milk supplies in communities of 10,000 or more population in Massachusetts

parallel and thus afford a common ground upon which effective milk control may be instituted.

The spread of human diseases through the medium of milk is of much greater epidemiological significance than the direct transmission of infections from cattle, and their prevention calls for certain precautions other than those here suggested.

Tuberculosis.—In 1898, Theobald Smith published the results of his extensive studies on tubercle bacilli from different sources—7 from human sputum, 5 from cattle, and 1 each from a cat, horse, and pig. His conclusions were that there exist “a distinctively human, or sputum, and a bovine variety of tubercle bacilli”. He describes with great clearness the differences that exist between these two types, in

their morphology, cultural characters, and virulence, especially for rabbits and calves.

With the difference between the two types of tubercle bacilli clearly defined, it was possible to determine with reasonable certainty whether the bacilli in a tuberculous tissue belonged to the human or to the bovine strain. Extensive researches on the types of tubercle bacilli were undertaken especially in the Gesundheitsamt in Berlin, by the British Commission on Tuberculosis, human and bovine, and in the research laboratory of the New York City Board of Health. In addition to these major investigations many specimens have been studied by different workers. The appended table, compiled by Park and Krumwiede from data obtained at the time bovine tuberculosis was at its peak in this country, gives the findings in a total of 1,220 examinations.

TABLE 4.—*Types of tubercle bacilli in 1,220 human infections*

Diagnosis	Adults of more than 16 years		Children from 5 to 6 years		Children younger than 5 years	
	Human	Bovine	Human	Bovine	Human	Bovine
Pulmonary tuberculosis.....	644	1	11	-----	23	1
Glandular tuberculosis (axillary or inguinal).....	2	-----	4	-----	2	-----
Cervical gland tuberculosis.....	27	1	36	21	15	21
Abdominal tuberculosis.....	14	4	8	7	9	13
Generalized tuberculosis (alimentary origin).....	6	1	2	3	13	12
Generalized tuberculosis (with meningitis, alimentary origin).....	29	-----	5	1	46	13
Generalized tuberculosis (with meningitis).....	5	-----	7	-----	52	1
Tuberculous meningitis.....	1	-----	3	-----	27	4
Bone and joint tuberculosis.....	27	1	38	3	26	-----
Genito-urinary tuberculosis.....	17	1	2	-----	-----	-----
Cutaneous tuberculosis.....	3	-----	1	-----	1	-----
Other tuberculosis:						
Of the tonsils.....	-----	-----	-----	1	-----	-----
Of the mouth and glands of the neck.....	-----	1	-----	-----	-----	-----
Of the maxillary sinus.....	2	-----	-----	-----	1	-----
Latent tuberculosis.....	-----	-----	-----	-----	-----	-----
Total.....	777	10	117	36	215	65

The commissions and laboratory mentioned report a total of 121 cases of tuberculous meningitis that have been studied. Twenty-one were in persons from 5 to 16 years of age, from which the human type was isolated in 19 cases and the bovine in 2. The remaining 100 were in children under 5 years of age, of which 80 contained the human and 20 the bovine bacillus.

Cobbett collected the reports of the examinations of 57 cases of abdominal tuberculosis, of which 10 were in adults. In 8 adult cases the human type was recovered, and both forms were present in 2. In the 47 cases under 16 years of age, 19 were due apparently to the human type and 28 to the bovine.

The examination of 49 cervical glands that had been removed surgically from adults showed that 40 contained the human and 9 the bovine organism. The study of 115 such cases in children between

the ages of 5 and 16, showed 52 to contain the human and 63 the bovine, and in 83 cases in children under 5 years of age 17 showed the human and 68 the bovine type.

According to Cobbett the prevalence of the bovine type in cervical glands that had been removed surgically from persons 16 years of age and younger varied considerably in different countries. In Scotland it was 87 per cent, in the United States 53 per cent, in England 50 per cent, and in Germany 35 per cent.

The probable source of infection is through raw milk from cows affected with tuberculous udders. Smith concluded that "bovine tuberculosis may be transmitted to children when the body is overpowered by large numbers of bacilli, as in udder tuberculosis or when certain unknown favorable conditions exist."

In the United States, the control of bovine tuberculosis is solving the problem of human infection with the bovine strains. In 1917 the Federal Government, in cooperation with the States, undertook to eradicate bovine tuberculosis by the accredited herd plan. Already large areas have been freed from this disease. There are 976 modified accredited counties in the United States. There are 2,435,000 herds that contain 20,983,000 animals that are once-tested-free. There are over 27,000,000 cattle now under official supervision and the work is progressing rapidly. In the month of June, 1930, there were 986,607 cattle tested. Nowhere have veterinarians undertaken a more comprehensive sanitary problem than in the elimination of tuberculosis from the cattle of this country. While this is being done, health officials are insisting on pasteurization which destroys tubercle bacilli, if they are present in the milk.

Undulant fever.—In recent years undulant fever has been recognized as one of the diseases of cattle communicable to man through milk.

Undulant fever is caused by *Brucella abortus* [*Brucella melitensis*], which is responsible for infectious abortion in cattle and swine. Bang and Stribolt, of Copenhagen, described this organism in 1897, but its infectiousness for man was not recognized until recently. Like tuberculosis, the specific organisms of infectious abortion found in different species have been differentiated into three distinct races or species, namely: *Brucella melitensis* [*Brucella melitensis* var. *melitensis*], the cause of Malta fever in man; *Brucella abortus* [*Brucella melitensis* var. *abortus*], the cause of infectious abortion in cattle, and which produces a disease in susceptible people similar to Malta fever; and *Brucella suis* [*Brucella melitensis* var. *suis*], the strain that has been isolated from swine.

The first case of human infection with *Brucella abortus* reported in America was described by Keofer in 1924. In 1926, Carpenter and Merriam reported two cases in Ithaca. The same year Moore and

Carpenter called attention to four others. By aid of the Hecksher Fund, Carpenter, Parshall, and Baker were able to study this disease and to test the pathogenesis of the specific organisms isolated from man on guinea pigs and pregnant heifers. They reported 18 cases in man. In addition they found *Brucella abortus* in 8 of 55 pairs of tonsils examined that had been removed by local surgeons.

The results of studies made at the New York State Veterinary College showed that in a period of two years 26 cases of undulant fever had been recognized in a population of 337,000, in a highly developed dairy district. There were no fatalities and but very few of the cases were seriously ill. All of them were in people who stated that they drank freely of raw milk. None of them were butchers or engaged in handling meat or in raising swine. In a number of instances the milk came from herds where Bang abortion disease was found to be prevalent. In one instance the "family cow" was the only one in the herd whose milk was infectious. An examination of the samples of market milk showed that approximately 20 per cent of the raw market milk sold in this territory contained *Brucella abortus* in sufficient numbers to produce lesions in guinea pigs. It was found also that from 20 to 35 per cent of the dairy cows that gave a positive agglutination test were eliminating the organism in their milk. However, of the cows that had actually aborted, 40 to 50 per cent harbored *Brucella abortus* in their udders.

Hardy collected the cases of undulant fever that had been reported in the United States up to July, 1929. He found a total of 1,296 cases distributed in 43 States. Of these less than 3 per cent were in children under 10 years of age. He did not include those cases reported from Texas, Arizona, and New Mexico, which are likely to be of goat origin. He records 223 cases from Iowa, of which 116, or 52.3 per cent, were in country people and 23, or 10.4 per cent, were in urban residents employed in packing houses. There were 30 cases, or 13.4 per cent, who lived in cities but who were not engaged in handling animals or meat, and 53, or 23.9 per cent, who lived in towns of less than 5,000 population.

There is a voluminous literature, including reports of cases, setting forth the supposed source of infection of this newly recognized disease in man. Undoubtedly there are many cases not reported, and it is possible that young children may be affected more often than it is now supposed. However, the data available suggest that undulant fever is not of so great an epidemiological significance as certain writers have implied. Smith has pointed out that the bovine type of *Brucella abortus* is so slightly invasive for man that it fails to produce appreciable disturbances, but that as a by-effect it may immunize toward the more virulent types of bovine and caprine origin. He also shows that the porcine type may become seeded in the udder

of the cow, just as hemolytic and scarlatinal streptococci, under certain unknown conditions, may gain a foothold in it, from which they are ingested with the milk.

The practical question with which this conference is concerned is, how can human infection from the strain or strains of *Brucella* that come to man through milk be prevented? Undoubtedly infections occur through the handling or working with infected animals and animal tissues, but these are separate from milk-borne infections. It is significant to note that the majority of cases recorded were in country people where pasteurization of milk is rare, or in those who lived in cities but were employed in packing houses.

Fortunately, the control of the milk-borne cases of undulant fever is not difficult. It involves the proper pasteurization of all market milk and that consumed on the farms, until the time when dairymen have eradicated Bang abortion disease from their animals. Well formulated and workable plans are advocated by competent veterinarians and also by a few State livestock sanitary boards to aid cattle owners in their efforts to eliminate this infection from their herds. "Sound animals only" is rapidly becoming the slogan of milk producers.

Septic sore throat.—In 1875 septic sore throat due to infected milk was recognized in South Kensington, England. In May, 1911, an outbreak occurred in Boston, Mass. Winslow made a careful epidemiological study of the 1,400 cases involved and found that 70 per cent were supplied with milk from one dairy. Smith isolated a streptococcus from the tissues of four fatal cases. The relation of streptococci to udder infection was suspected as early as 1884 by Nocard and Mollereau. The epidemics of septic sore throat traced to milk infection that have been reported since 1910 are numerous and the total number of cases extends into the thousands with many deaths. The one in Chicago in 1911 reported by Capp and Miller is estimated to have numbered 10,000 cases and the one in Lee, Mass., in 1928, involved 1,000 cases with 40 deaths. The United States Public Health Service reports from 1918 to 1926, inclusive, 16 epidemics with 3,179 cases and 34 fatalities. In 1929 there were reported in the United States 7 epidemics with 739 cases and 13 deaths, and in Canada 4 epidemics with 37 cases and 3 deaths. Measured by the number of fatalities, septic sore throat is the most serious of the milk-borne diseases traced to udder infection. However, it occurs among adults more than in young children. In the Lee epidemic only 20 per cent of the cases were in persons under 15 years of age.

Extensive studies have been made to differentiate the form of mastitis that is responsible for this affection. More recent studies have shown that the streptococci found in mastitis belong to at least

two distinct groups or species, namely, *Streptococcus epidemicus* that causes septic sore throat in man, and *Streptococcus mastiditis*, the cause of certain udder troubles. *Streptococcus epidemicus* is believed by many bacteriologists to be of human origin. The explanation is, that it finds its way into the milk ducts of the udder from infected persons, multiplies in the milk in the udder, and escapes with it. This streptococcus may be present in large numbers before lesions in the udder appear and before there are symptoms to arouse suspicion on the part of the milker.

The control of this form of septic sore throat rests in efficient pasteurization, since the streptococcus causing it may not produce tissue changes in the udder of the infected cow and can not always be excluded by physical examination.

Scarlet fever.—While the causative agent in milk-borne scarlet fever is considered generally as coming from a case of human infection, transported in milk, there is evidence that *Streptococcus scarletinae* may become located in the udders of cows where it multiplies and causes a definite mastitis. In such cases the diseased udder becomes a source of supply for the distribution of the specific streptococcus. Jones and Little were the first to furnish bacteriological evidence that cows could be infected with the scarlet fever organism. They reported a case where the milk of an infected udder contained 345,000,000 streptococci per cubic centimeter. The streptococcus answered all the requirements for that of scarlet fever.

Jones has pointed out that milk, under ordinary conditions, inhibits the growth of scarlet fever streptococci and that the usual opinion that milk-borne epidemics of this disease are due to a human case or carrier on the farm, or in the dairy, may be erroneous, as the cause may have its immediate origin in an infected udder. The present knowledge indicates that dairy cattle should be protected against infection from human carriers. In addition, the milk should be pasteurized.

Mastitis.—In recent years a number of outbreaks of illness, largely among children, and usually of short duration, have been reported following the consumption of milk from cows suffering with mastitis and from which streptococci were isolated. The reports by Massey in the London Lancet and by Laidlaw in a New York State journal of medicine, suggest that streptococci in cases of mastitis may be injurious. Acting on this supposition, veterinary inspection of dairies is being increased and more attention is being given to pasteurization.

Miscellaneous disturbances.—A disease of cattle known as “trembles” has been reported from certain restricted areas in the United States. The milk of affected cows transmits the disease to man.

In case of catarrhal and parenchymatous mastitis, the pus present in the milk may be harmful, especially to young children. In cases of disease in which cows have a high temperature, the milk may cause unpleasant symptoms. Milk from cows suffering from indigestion may possess properties of an irritating nature.

The greatest factor in the protection of milk against contamination of all kinds is the human equation. Knowledge and regulations are too often neglected both by milk producers and by consumers. Milk to remain wholesome must be cared for properly after it leaves the udder. This involves an intelligent understanding of its nature and how to protect it. Improvement depends on the application of sanitary principles. The course for obtaining an almost perfect milk supply in this country is blazed unmistakably and in the main the people are following the trail.

From the data gathered from a large number of reports and results of special researches on the transmission of disease from cattle to man through milk, the intensive work of the Federal and State Governments to eradicate bovine tuberculosis in this country, the active interest that is being taken by many dairymen and a few States to eliminate Bang abortion disease, the thorough physical examination of dairy cows by competent veterinarians and the exclusion of diseased individuals required by the large milk companies and many municipalities, and the demands of health officials in all large and most smaller cities that, *in addition to the precautions in its production, market milk should be pasteurized*, the following conclusion may be drawn: That the diseases mentioned in this report would, under solely natural conditions, become a serious menace to human health; but that the measures imposed by municipalities generally, and exacted by all responsible milk distributors to safeguard it against all possible contamination and infections, eliminate, for the greater part, the danger otherwise imminent, except for residents of rural districts and smaller towns where the preventive measures, especially pasteurization, are as yet not observed as fully as they are in the larger centers. The result of these united efforts is to give the American public a progressively cleaner and safer market milk.

RECOMMENDATIONS

I. That pasteurization be required wherever practicable.

II. That pasteurization is not intended to take the place of the sanitary production of clean and wholesome milk, but rather to provide the final factor of safety from milk-borne diseases.

III. That cooperative effort between producers, control, and educational officials give promise of the best and most lasting results.

IV. That in the absence of local milk control the State must assume this responsibility.

Dr. S. J. CRUMBINE, *Chairman.*

Dr. V. A. MOORE.

LUCIUS P. BROWN.

Report of the Subcommittee on the Public Health Supervision of Milk

The subcommittee on the public health supervision of milk has attempted to formulate answers to the following questions:

(1) What are the essential elements of the public health supervision of milk supplies?

(2) What fundamental items should be included in the laws or regulations relating to the public health supervision of milk supplies, and what agencies should enforce them?

(3) How should the results of the enforcement of the laws or regulations for the public health supervision of milk supplies be evaluated?

(4) What is the present status of the public health supervision of milk supplies in the United States?

(5) What recommendations should the White House Conference make with reference to the future improvement of the public health supervision of milk supplies in the United States?

WHAT ARE THE ESSENTIAL ELEMENTS OF THE PUBLIC HEALTH SUPERVISION OF MILK SUPPLIES

Since 40 or more milk-borne outbreaks of disease are reported annually in the United States with a resultant unnecessary toll of death and disease, all official public health agencies should be empowered to apply all essential public health measures for their prevention. These should include:

(a) Inspection of farms and plants;

(b) Supervision of the physical examination and testing of cows;

(c) Laboratory examination of milk;

(d) Physical examination of workers and residents at farms and plants, including laboratory examination of body discharges; and

(e) Pasteurization control of general market milk.

(a) *Inspection* is designed to disclose whether the necessary public health precautions have been applied at the farm and plant, and therefore whether the degree of cleanliness and safety of the milk supply which these precautions provide has been assured. To be most effective inspections should be made at irregular but frequent intervals by competent inspectors.

However, sanitary inspection can not protect against infectious cows or infectious employees, nor can it insure the maintenance of proper methods between inspections. Therefore this milk control

measure can not alone be depended upon to insure a clean, safe milk supply.

(b) *Physical examination and testing of cows.*—Studies of the relation of bovine diseases to the public health have emphasized the importance of periodic physical examination and testing of cows for certain diseases transmissible by cows through milk to man. Much can be done by means of this measure to reduce disease transmission through milk, although the examinations and tests are not infallible and can not be made at sufficiently frequent intervals to insure the absence of infectious cows from the herds at all times.

(c) *Laboratory examination of milk.*—Laboratory examination of milk provides a valuable index with respect to cleanliness and safety and is deserving of both more intensive and more extensive use. Such examinations provide useful supplementary information. However, no known practicable laboratory examination of milk supplies will dependably disclose the existence of infectious cows, infectious employees, insanitary privies, unsafe water supplies, or fly contamination. Therefore, laboratory examination of milk should not alone be relied upon to insure a clean, safe milk supply.

(d) *Physical examination of workers and residents at farms and plants.*—Studies of the epidemiology of milk-borne outbreaks of disease have emphasized the importance of making periodic physical examinations of workers and residents at farms and plants, including laboratory examination of body discharges. Many epidemics of typhoid fever, for example, can be prevented by this measure. However, since such examinations are not infallible and can not be made at sufficiently frequent intervals to insure the absence of infectious persons from farms and plants at all times, this measure, while useful, should not alone be relied upon to prevent the transfer of infection from such persons to the milk.

(e) *Pasteurization control.*—Pasteurization, properly done, renders harmless or destroys all disease-producing organisms known to be transmitted through milk to man, and does not significantly impair or alter the flavor and food value of milk.

Because of the fact that the public health measures previously discussed are not of themselves completely protective, either singly or in combination, pasteurization control may be regarded as a necessary final public health safeguard for all general market milk supplies.

However, even pasteurization is subject to the fallibility of its operators; and while all health officers should persistently emphasize the fact that all milk may advantageously be pasteurized before it is consumed, either in a properly supervised commercial plant or at home, this measure should not be considered as rendering unnecessary any of the previously discussed measures. Pasteurization should go hand in hand with all other essential public health measures in order to insure a clean, safe milk supply.

WHAT FUNDAMENTAL ITEMS SHOULD BE INCLUDED IN THE LAWS AND REGULATIONS RELATING TO THE PUBLIC HEALTH SUPERVISION OF MILK SUPPLIES AND WHAT AGENCIES SHOULD ENFORCE THEM?

The first part of this question will be discussed under three subdivisions, namely, municipal, State, and federal legislation.

Municipal milk ordinances or regulations.—Municipal milk ordinances should be definite, clear, and brief. They should contain the following elements:

- (a) Definitions of milk, milk products, and other terms used in the ordinance or regulation;
- (b) Prohibition of the sale of adulterated milk and milk products;
- (c) Provision for permits, and for permit revocation;
- (d) Requirements governing the labeling of containers;
- (e) Requirements relating to the frequency of inspection and reinspection, and the posting of inspection reports;
- (f) Requirements relating to the frequency of taking milk samples, and to the laboratory examination thereof;
- (g) Specifications for certified milk, grade "A" raw milk, and grade "A" pasteurized milk; and
- (h) One of two alternative devices for punishing violations of grade requirements, namely—

For cities which wish to maintain high grade supplies by the de-grading method this section should provide that when a given milk supply is found to violate the specifications under which it is labeled, it shall be labeled with one of a number of lower-grade letters, depending upon the nature of the violation. In this case the specifications for the various lower-grade labels should be added to section (g).

For cities which wish to maintain high-grade supplies by the permit-revocation method, this section should provide that when a given milk supply is found to violate the specifications under which it is labeled it shall be barred from the market by revocation of permit. In this form of ordinance the lower-grade specifications need not be included in section (g).

- (i) The usual sections relating to penalties; repeal of conflicting, prior legislation; date of effect; and unconstitutionality.

State milk laws or regulations.—It is generally conceded that centralized and standardized administration tends to lead to greater efficiency and to a lower per capita cost, but may also lead to an undesirable expansion of bureaucracy. On the other hand, decentralized administration, if undirected, tends to lead to inconsistency and inefficiency of method. The subcommittee believes that so far as possible every municipality should regulate its own milk supplies, but that all municipalities should attempt to secure the advantages

of centralized administration, without incurring its disadvantages, through a voluntary program of standardization of methods.

The opinion is held in some States, however, that milk supervision should be placed on a State law basis. For States which prefer this plan the subcommittee recommends that the State law contain essentially the elements previously enumerated for municipal milk ordinances. The law may be enforced either directly by State personnel or may make enforcement by all municipalities in a specified classification mandatory.

States which desire to promote a *voluntary* uniformity of municipal supervision through State legislation may pass essentially the same regulations as above except that provision is made that they shall be in force only in such localities in which they are approved by the city or county health department.

Finally many States, probably the majority for many years, will wish to promote voluntary uniformity entirely without the agency of State legislation. For these the best plan is for the State to promulgate an *advisory* standard municipal milk ordinance and to encourage its local adoption.

The subcommittee believes that there is as yet insufficient evidence to justify a conclusion as to the relative excellence of these methods.

Federal legislation relative to the public health aspects of milk and milk products.—The Federal Government is now authorized by Congress, and should continue to be so authorized—

(a) To conduct research and to make investigations and surveys on all phases of the public health supervision of milk and milk products, and to publish the results thereof;

(b) To enforce legislation relating to the interstate aspects of the public health supervision of milk and milk products; and

(c) To give advice and cooperative assistance to State and local public health authorities with reference to the public health aspects of milk and milk products.

What agencies should enforce the laws or regulations relating to the public health supervision of milk supplies?—The supervision of milk, cream, and other dairy products is of vital public health concern and economic importance, and should receive the coordinated attention of all State and local agencies, including public health authorities, agricultural departments, and agricultural, educational, and extension organizations within the State or community. The subcommittee recommends that inasmuch as the laws and regulations in question deal only with measures which are designed primarily to protect the public health, they should, where practicable, be made the function of health authorities, local, State, and Federal. The public health supervision of municipal milk supplies should obviously be the function of governmental departments primarily dedicated to

the public health point of view and technically trained in the recognition of all public health aspects of the problem.

HOW SHOULD THE RESULTS OF THE ENFORCEMENT OF THE LAWS OR REGULATIONS FOR THE PUBLIC HEALTH SUPERVISION OF MILK SUPPLIES BE EVALUATED?

Periodic ratings of the public-health status of milk supplies are necessary in order to insure a constantly maintained alertness and efficiency on the part of the responsible public-health officials and in order to provide a measure of progress from year to year. The subcommittee recommends that all municipalities should be surveyed and rated as frequently as practicable.

All such ratings should be based upon a common standard in order that they may be comparable. The grade A raw milk and grade A pasteurized milk requirements of the Standard Milk Ordinance may conveniently be used as such a common standard. These grades are the most widely used milk standards in existence to-day. They represent standards of quality which, if satisfied, would make the raw milk as safe as raw milk can practicably be made, and would make the pasteurized milk as safe as any milk can be made. Following is a discussion of a method of determining municipal, State, and Federal ratings.

The determination of municipal milk-sanitation ratings.—A proper milk-sanitation rating is one which measures the percentage extent to which all practicable public-health precautions have been applied. Such a rating can therefore be obtained by determining the percentages of the milk supply complying with each of those precautions and then finding the weighted average of these percentages. The weighting should be done on the basis of the relative importance of the various precautions. Such a system of weights has been developed by the Public Health Service in connection with its survey methods.

In order to obtain a comprehensive index it is advisable to compute two specific ratings, namely, the rating of the retail raw milk and the rating of the pasteurized milk. These two ratings together with the percentage of milk pasteurized will give a valuable estimate of the protection enjoyed by the milk consumer.

The determination of State and national ratings.—State ratings can be computed by determining the average of the municipal ratings, weighted on a gallonage basis. National ratings can be computed by determining the average of the State ratings, weighted on a gallonage basis, or by determining the average of the ratings of a sufficiently large group of representative cities, weighted on a gallonage basis.

The rating of enforcement methods.—In addition to the above ratings of the results of enforcement effort, the subcommittee further believes that the characteristics of the effort itself should be rated in

order to make apparent how effort and result are related, and what specific defect in effort had led to any given, low "result rating."

The rating of effort may be accomplished by establishing a schedule of enforcement measures, such as inspection, sampling, etc., and estimating on a percentage basis the degree of completeness with which the health officer has applied each measure. The average of these percentages, weighted on a relative importance basis, will yield a useful effort rating.

WHAT IS THE PRESENT STATUS OF THE PUBLIC HEALTH SUPERVISION OF MILK SUPPLIES IN THE UNITED STATES?

This question can be answered only by applying some standard yardstick, such as a standard schedule of items of sanitation. The most widely used schedule of public health requirements for milk control in use in the United States to-day is that embodied in the Standard Milk Ordinance. Therefore, the subcommittee has studied rating surveys made on that basis by the Public Health Service during the past several years.

These surveys include in all 430 American cities with a total population of 13,290,669. They are located in 21 States. Of the 430 cities, 247 had passed the Standard Milk Ordinance from a few months to seven years prior to the date of survey.

The following tables give the results of the surveys, computed on the basis of the evaluation method described in the preceding chapter of this report.

It should be noted that the figures in the tables are subject to minor revision after the Public Health Service has completed its surveys of all States. Any necessary revisions will be included in a supplementary report.

Inasmuch as the rating is based upon the items of sanitation required for grade "A" raw and grade "A" pasteurized milk in the Standard Milk Ordinance the following table gives separately the figures for Standard Ordinance and nonstandard Ordinance cities:

TABLE 1.—Average status of the public health supervision of milk supplies in American municipalities, 1929-30

	Cities enforcing provisions of Standard Ordinance	Cities enforcing other standards
Total number of cities surveyed.....	247	183
Total population of cities surveyed.....	4,472,236	8,818,433
Total number of States in which cities are located.....	14	11
Total daily milk sales represented in survey..... gallons..	330,673	981,108
Total number of retail raw milk dairies surveyed.....	3,002	2,409
Total number of pasteurization plant producers surveyed.....	2,494	5,003
Total number of pasteurization plants surveyed.....	237	960
Average percentage of milk pasteurized..... per cent..	50	90
Average rating of raw milk..... do.....	90	65
Average rating of pasteurized milk..... do.....	87	60

From Table 1 it is evident that the raw milk sold in cities enforcing the Standard Ordinance averages 90 per cent compliance with the grade "A" raw milk requirements, and that the pasteurized milk sold averages 87 per cent compliance with the grade "A" pasteurized milk requirements, as compared with compliance figures of 65 per cent and 60 per cent, respectively, in cities enforcing other ordinances. Whenever the milk supply is improved in quality, consumption invariably increases.

The difference in the percentage of milk pasteurized in these two groups represents a regional difference and not a difference in the two groups of milk regulations. This is demonstrated by the fact that the quantity of pasteurized milk in the cities enforcing this standard milk ordinance has doubled within an average period of approximately three years.

The higher ratings shown by cities enforcing the Standard Ordinance should not be taken as implying that no other type of ordinance will yield as high ratings. In fact it is undoubtedly true that many cities enforcing other types of ordinances have produced excellent milk supplies. The above figures represent averages only for the areas surveyed.

In addition to the above figures the subcommittee has considered it advisable to present an analysis of the survey results by size of city. These are given in Table 2, from which the following conclusions are noted:

(a) Retail raw milk tends to improve in quality as the size of the city increases.

(b) The quality of pasteurized milk shows no consistent trend, but there is a decided improvement in pasteurized milk when the 100,000 population group is reached.

(c) The percentage of milk pasteurized increases with size of city.

(d) The average quality ratings for both raw and pasteurized milk are consistently higher for cities enforcing the Standard Ordinance than for cities of the group studied enforcing other standards, throughout the range of population groups.

TABLE 2.—Average status of the public health supervision of milk supplies in American municipalities by size of city, 1929-30

	Cities enforcing provisions of the Standard Ordinance				Cities enforcing other ordinances			
	Under 10,000	10,000 to 50,000	50,000 to 100,000	100,000 and over	Under 10,000	10,000 to 50,000	50,000 to 100,000	100,000 and over
Total number of cities surveyed.	139	85	17	6	87	68	9	19
Total population of cities surveyed.	592,071	1,592,756	1,105,142	1,182,267	453,402	1,529,680	645,397	6,189,954
Total number of States in which cities are located.	11	13	9	2	11	11	5	7
Total daily milk sales, gallons.	35,637	109,745	83,534	101,757	41,059	156,067	77,084	706,293
Average percentage of milk pasteurized.	19	42	46	73	48	73	91	96
Average rating of raw milk.	88	89	90	95	55	61	66	78
Average rating of pasteurized milk.	82	82	81	92	53	53	56	62

WHAT RECOMMENDATIONS SHOULD THE WHITE HOUSE CONFERENCE MAKE WITH REFERENCE TO THE FUTURE IMPROVEMENT OF THE PUBLIC HEALTH SUPERVISION OF MILK SUPPLIES IN THE UNITED STATES?

The subcommittee suggests that the following recommendations relative to the future improvement of the public health supervision of American municipal milk supplies be included with the general recommendations of the White House conference.

(a) Municipal milk-control measures should include supervision of the inspection of farms and plants, physical examination and testing of cows, laboratory examination of milk, physical examination of workers and residents at farms and plants, including laboratory examination of body discharges, and pasteurization control.

(b) All health authorities should persistently recommend to American milk consumers that pasteurization is an added factor of safety in a milk supply.

(c) All laws or regulations for the public health supervision of milk supplies, whether local, State, or Federal, should incorporate in so far as practicable uniform requirements at least the equivalent of those now contained in the standard milk ordinance recommended by the United States Public Health Service.

(d) The Federal Government should continue its present functions in research, investigations, surveys, publications, and advisory assistance to local and State health authorities with reference to the public-health aspects of milk and milk products.

(e) The supervision of milk, cream, and other dairy products is of vital public-health concern and economic importance, and should receive the coordinated attention of all State and local agencies, including public health authorities, agricultural departments, and agricultural, educational, and extension organizations within the State or community. The subcommittee recommends that inasmuch as the laws and regulations in question deal only with measures which are designed primarily to protect the public health, they should, where practicable, be made the function of health authorities, local, State, and Federal. The public-health supervision of municipal milk supplies should obviously be the function of governmental departments primarily dedicated to the public-health point of view and technically trained in the recognition of all public-health aspects of the problem.

(f) The milk supplies of all municipalities should be surveyed and rated as frequently as practicable in accordance with the method previously described in this report.

(g) Milk-control areas should provide adequate enforcement machinery in order to insure satisfactory results.

LESLIE C. FRANK, *Chairman*.

CHAS. O. H. LAUGHINGHOUSE, M. D.⁴

FRANK C. WILSON.

Report of Subcommittee on the Nutritional Aspects of Milk

Milk is a fluid secreted by the mammary gland for the nourishment of the young. It is variable in composition, depending upon species, breed, age, period of lactation, intervals between emptying the gland, time of year, and diet. Analyses of individual samples are not trustworthy in furnishing evidence for the composition of all milks. Cow's milk contains more proteins and ash than does human milk. If fed to infants the former must be modified by dilution with water and addition of carbohydrate. The fat content may be regulated by selecting milk from different breeds of cows. The principal constituents of milk are protein (casein, lactalbumin, lactoglobulin), carbohydrate (lactose), fat, mineral salts, vitamins, pigments, enzymes, and traces of numerous other substances. Most investigations have been carried out with cow's milk.

Casein is the protein most easily separated in a state of relative purity from milk. It has been more studied than any other protein. There is much reason to believe that even the purest casein still contains impurities. Some evidence has been brought forward to indicate that it is of dual nature. It is doubtful whether pure casein has ever been prepared. Even the question of homogeneity of casein has been raised. No significant differences have been detected in the elementary composition of caseins from different milks. Highly delicate immunological reactions seem to show that casein from the milk of one species is the same as that from the milk of another.

That two samples of milk with the same composition may not be equally readily digested by infants is shown by common experience. Some have attributed this to the differences in the size of the fat globule, others to the state of division of the curd. Human milk is well tolerated by infants, yet it contains fat globules of all sizes ranging from the smallest to the largest found in cow's milk. This seems to argue against the validity of the fat globule size theory of the relation between the state of fat in a milk and its quality in infant feeding.

Toughness and coarseness of curd have often been mentioned as qualities affecting the digestibility of milk. Curd of cow's milk is precipitated to a varying extent by hydrochloric acid, depending upon the breed of the cow. The precipitated curd from certain breeds is coarser than that from others. Hill has shown that the curds of milk from individual cows vary in toughness. This applies to all breeds.

⁴ Deceased.

Toughness of curd remains fairly constant throughout the lactation period. Curd is somewhat tougher in the early stages of lactation and becomes softer toward the end. Toughness is not influenced by the fat content and there is no good evidence that the feed of the cow exerts any effect. The curd property, which is an individual characteristic of the cow, is believed to be an inheritable character. Hill found that milk with curds of varying toughness are not tolerated equally well by infants. Experience seems to have shown that an infant fed soft curd milk may thrive, whereas fed tough curd milk it may have digestive disturbances.

Milk is an almost complete food. Its proteins are of high quality. This means that they furnish a mixture of amino-acids in favorable quantitative relations for transmission into body proteins during growth. Its value may be enhanced by the addition of the sulphur-containing amino-acid cystine.

The carbohydrate lactose contributes about 29 per cent of all calories coming from milk. The fat of milk is especially important in that it is one of the few food fats containing vitamin A. The ash of milk is especially rich in calcium. Since all cereals, meats, eggs, roots, tubers, and fruits are deficient in this element, milk is an important supplementary food for providing calcium. The absolute amount of calcium which the daily diet of an infant or child should contain has been the subject of a number of investigations, but the question has not been satisfactorily answered. All experimenters are agreed that the calcium of milk is easier of assimilation than is this element from vegetables. Since in the diet of the infant and young child the calcium is derived largely from milk, the calcium requirements of the child will determine in great measure the content of milk in its food. It is generally agreed that all growing children up to the age of 14 should consume a liberal amount of milk in their daily diet unless there are specific contra-indications. The absolute amount of calcium daily retained by children increases as the milk in the diet is increased up to approximately 1 quart a day.

The most striking deficiency of milk is iron. Infants and young animals restricted to milk or milk and iron-poor foods for a considerable period develop anemia. Studies on blood regeneration have demonstrated that iron can not be utilized for hæmoglobin formation unless accompanied by a small amount of copper, and milk has been shown to be deficient in this element. The nutritional anemias which have been studied in animals have not been investigated thoroughly in infants, and so little can be said on this subject as respects human nutrition. The proportion of iron in the body is higher at birth than at any subsequent period. As the body grows in weight and size the proportion of iron decreases if the food is

deficient in iron, as is often the case in improperly fed infants and young children.

Milk fat is a good source of vitamin A and contains a small amount of both D and E. The nonfat portion of milk appears to be somewhat deficient in vitamin B, the antineuritic principle, but to contain more of the antipellagra principle, vitamin G. Raw milk always contains some of the antiscorbutic vitamin C. The studies of Macy have shown a pronounced deficiency of vitamin B in both human and cow's milks as to indicate the advisability of supplementing the diet of the infant at an early age with a source of this vitamin richer than milk. It is of great significance that the content of vitamin B in the milk can be markedly increased by including in the diet of a lactating mother foods rich in this principle.

The composition of milk may be varied by a number of conditions, among them the diet of the mother. Milk yield as well as composition may be so influenced. Overfeeding produces no change either in yield or composition of milk. Underfeeding produces significant changes, especially in an increase in the percentage of fat in the milk, but the yield tends to fall off. Raising the protein content of the food increases the quantity of milk produced. The quality as well as the quantity of protein of the food exerts complex effects upon milk composition. The inorganic constituents of milk remain fairly constant over relatively long periods even though the amounts of individual elements in the mother's diet vary within wide limits. Lactating animals remain for long periods in marked negative calcium-phosphorus balances while maintaining the normal milk yields. On diets deficient in these elements the mother therefore sacrifices herself to maintain the composition of the milk constant for the preservation of her young. Changes in the vitamin content of the diet influence directly the content of these nutrients in the milk rather than the amount of milk. The vitamin content of the milk may be decreased by deficient diets more readily than can be the content of any other milk constituent.

Colostrum, the fluid secreted by the mammary gland during the early days of lactation, differs from milk in the presence of certain cells known as colostrum bodies. It contains also a high content of globulin. These peculiarities in its composition have suggested that it has some special function in protecting the infant. Colostrum contains antibodies. The content of these parallels the amount of globulin. Certain species of young are susceptible to infectious diseases when colostrum is not given them, whereas the young fed from the breast immediately after birth remain free from such diseases. This has not been shown to apply to human subjects. In cattle and goats it appears especially that there is a transmission of immunity from mother to new-born young through the agency of colostrum,

but the latter appears to play a negligible rôle in the transmission of immunity in rats, guinea pigs, and rabbits. The belief prevails that colostrum is not essential to the infant, but scantiness of literature upon the subject and the contradictory findings of different workers make further investigations on this subject desirable.

This report includes in concise form the important facts concerning pasteurized milk, condensed milk, evaporated milk, powdered and dried milks, and malted milk, from the nutritional standpoint. There has been a growing tendency in recent years to pasteurize the milk supplies of cities. The percentage of milk pasteurized is far greater in large cities than in small cities, while villages and country districts still have generally only a raw milk supply. In 1924 the cities of over 500,000 population pasteurized 98.1 per cent of their milk, whereas cities of less than 10,000 pasteurized 33.6 per cent of their milk. Nearly all health authorities in this country are urging the pasteurization of market milk, since this prevents the dissemination of disease through this food.

The production of condensed milk has tended to decrease during recent years, but in 1928, 3,311,357 cases of 48 cans each were produced in the United States. Condensed milk contains about 42 per cent of sugar and 27.4 per cent of water. A number of investigators have shown that the vitamin content of condensed milk is practically the same as ordinary raw whole milk. This is evidently due to the fact that the evaporation is carried out in a vacuum so that there is little tendency to the oxidation of vitamin C.

Many investigations have established a low bacterial content of condensed milks, but they all contain some bacteria and molds. The development of these is inhibited by the high content of sugar and there is evidence that storage in sealed containers results in a decrease in the number of organisms which survive the canning process.

There has been a tendency in recent years away from the use of condensed milk in infant feeding, although many pediatricians still continue to use it in special cases. Its principal use is for household and culinary purposes and in bread making and the manufacture of ice cream.

While the production of condensed milk has tended to decrease, the production of evaporated milk steadily increased between the years 1912 and 1918. Since 1918 the annual production has ranged between 19,000,000 and 25,000,000 cases of 48 cans each. Evaporated milk has enjoyed increasing popularity in infant feeding in recent years.

In evaporated milk the antiscorbutic vitamin is completely destroyed. Otherwise the fat value of evaporated milk is not sufficiently different from fresh milk to warrant an unfavorable comparison. It is practically sterile bacteriologically and of superior digestibility.

Powdered whole milk manufacture has increased from about 4,000,000 pounds in 1918 to nearly 11,000,000 pounds in 1926. Powdered skim milk during the same period increased from 26,000,000 pounds to nearly 92,000,000 pounds. The total production of all dried milk products in 1927 amounted to 196,396,000 pounds. Dried milk is used as a general substitute for liquid milk, infant feeding, household and culinary purposes, and industrially in bread making, the manufacture of candy, confectionery, and ice cream. To some extent it is used in stock feeding.

From the standpoint of nutritive properties it may be said that dried milks manufactured by either the spray or roller processes compare very favorably in all respects except the antiscorbutic property with fresh milk.

RECOMMENDATIONS

Notwithstanding the immense amount of research which has been done upon milk, there still remain a number of very important questions which require further study. Among these are the following:

1. Studies on curd tension, which is a measure of the toughness of the curd formed by rennet coagulation, seem to have established a unique value of soft curd milks in infant feeding. This property applies also to older children and adults whose digestive powers are not vigorous. Further confirmation of the work thus far done in feeding soft curd milks to infants is highly desirable.

It appears that the curd tension of milk can be greatly reduced—that is, the curd softened—by homogenization of milk, which is the breaking up of the fat globules into finer globules by mechanical means. It may thus prove feasible to render all milk soft curd milk and so improve its digestibility.

2. The vitamin content of milk, especially the water-soluble vitamins B and G, as determined by the biological assay, should be further studied. Such studies should be correlated with accurate determinations of the nutritive needs of the young for these vitamins.

3. A most important phase of nutritional research is that related to the biological values of proteins. Investigators have been much handicapped by their inability to secure considerable amounts of the 18 or more individual amino-acids into which proteins are digested. Very little progress has been made during the past 25 years in devising procedures for the isolation of amino-acids in pure form. Studies in this direction are highly desirable, and form a phase of research on the limiting factors in a chemical sense of milk as a food.

4. Further metabolism studies should be made on children to determine the optimum proportions of milk in the diet. The disagreement of experienced scientists and clinicians on this point emphasizes the need for information as to the proportions between milk

and other foods suitable for inclusion in the diet of infants and children which afford the optimum supplementary relations. Such studies should include calcium assimilation, the effect of the ratio of calcium to phosphorus, the adequacy of vitamins B and G in the diet, and the influence of the proportion of milk to other foods on the biological value of the total protein content of the food combination studied.

5. Further studies are recommended on the nature of the colostrum cell and its significance in the nutrition of the new-born.

6. The demonstration of Macy and coworkers of the nutritive deficiencies of human milks when produced by women whose diet is not satisfactory, and that the inclusion of certain vitamin-rich foods tends to markedly improve the quality of the milk, emphasizes the importance of further fundamental studies of this character.

7. There is need of further standardization of apparatus, installation, and operation of pasteurizing equipment in milk plants. A fundamental research on the several types of equipment for pasteurizing milk is recommended.

8. Since there are areas where milk could be economically produced but where no market is available near at hand, it appears economically desirable to increase the production of milk powders, evaporated milk, and condensed milk. From a standpoint of economy it is also imperative that the surplus milk during the flush season be preserved by one or another of these processes. A careful research on the economic aspects of replacement of liquid pasteurized milk or certified milk by milk powder, condensed, and evaporated milks is of importance.

9. Further study is needed by pediatricians of the specific conditions in which different kinds of milks (certified, pasteurized market, boiled, condensed, evaporated, milk powders, acidified milks, etc.) are indicated in infant feeding.

10. It is known that at least 10 inorganic elements are essential in the diet for normal nutrition. There are a number of inorganic elements present in minute amounts in the various foods including milk. Their significance, if any, is still unknown. Investigations to demonstrate which of these play a physiological rôle might yield important results.

11. Further studies are desirable on the chemistry of casein, its amino-acid composition and the supplementary relations of casein to other heat coagulable proteins of milk.

12. A study of the nutritive qualities of whey and whey powder. This product, now manufactured in small amounts, seems to possess, when taken in the right amounts, a mild regulatory action on the

intestinal tract which may make it desirable to recommend its wider use in nutrition.

Dr. E. V. McCOLLUM, *Chairman.*

Dr. F. W. SCHLUTZ.

Dr. JAMES A. TOBEY.

Report of Subcommittee on Economic Aspects of Milk

I. CONSUMPTION OF FLUID MILK AND CREAM

Milk and the dairy industry are inseparably linked to the Nation's health and the normal growth and development of its people. Scientific studies have shown that the food people eat, especially during the periods of rapid growth in early childhood, has a lasting effect on the size of the entire race. President Hoover, when addressing The World's Dairy Congress in 1923, as Secretary of the Department of Commerce, said: "The exhaustive researches of nutritional science during the last two decades have, by the demonstration of the imperative need of dairy products for the special growth and development of children, raised this industry to one of the deepest national and community concern, for, as I have said, it is not alone the well-being of our people but it is the very growth and the virility of our race to which you contribute."

According to the latest figures available, the per capita consumption of fluid milk in 1926 in the United States was 55.3 gallons per year, or slightly more than 1 pint per day. In 1926, the most recent year for which figures are available, four European countries exceeded the United States in the per capita consumption of milk. These were Finland, with a consumption of 83.9 gallons; Switzerland, 70.4 gallons; Sweden, 69.7 gallons; and Norway, 56.0 gallons.

Nutrition experts state that for proper nutrition and health a normal growing child should receive approximately a quart of milk daily during the years of rapid growth, and that each adult should consume at least a quart of milk or its equivalent in butter, cheese, and ice cream.

Surveys have shown that the average child is getting considerably less than a quart of milk a day. On the average farm more milk is consumed per capita than in cities, though this is not true in certain specific localities. The increase in the per capita consumption of milk for the United States as a whole has been a gradual one. In 1921 the yearly per capita consumption was 49 gallons as compared with 55.3 gallons in 1926.

Doctor Sherman, of Columbia University, after extensive experiments, concluded that a child should receive a quart of milk per day to insure the optimum storage of calcium and phosphorus and the best development of bones and teeth. He also said that the calcium in

milk is superior to the calcium in vegetables as a source of that element for growing children.

Production in the United States is ample to care for future increases in consumption of fluid milk. If the per capita consumption should increase as much as 15 per cent, it would take only 55 per cent of the present total production. Such an increase in consumption of fluid milk would mean that it would be necessary to divert a part of the milk supply that now is used for manufacturing purposes into fluid milk markets. In June of this year the average price received at the farm for milk to be consumed as fluid milk, was \$2.70 per hundred-weight, as compared to \$1.60 for milk sold to be manufactured into butter, cheese, and other products. If children, young people, and adults were consuming the quantity of milk required for proper nutrition and health, the diversion of this extra milk from butter, cheese, and other products to fluid-milk uses, could be accomplished very readily.

II. CONSUMPTION OF OTHER MILK PRODUCTS

The value of condensed and evaporated milk in place of fluid milk was fully demonstrated during and immediately after the World War. In 1919 the equivalent of more than 2,000,000,000 pounds of milk was exported to Europe in condensed, evaporated, or dried form.

Until recently, condensed, evaporated, and dried milk were consumed principally in sections where dairying had not been developed, or where geographic or climatic conditions made dairying impossible or unprofitable. In more recent years, these products have been sold in increasing amounts in home markets.

Physicians and dietitians have found evaporated and dried milk to be valuable in formulas for infant feeding. The use of these products in home cooking has increased also. Bakers and candy makers are using dried skimmed milk in their products, and ice cream manufacturers use dried skimmed milk as well as plain evaporated milk and sweet-cream unsalted butter.

Nearly 47 per cent of the milk produced in the United States is used as fluid milk or cream. The per capita consumption of milk in 1926 was 55.3 gallons; butter, 17.82 pounds; cheese, 4.36 pounds; condensed and evaporated milk, 14.32 pounds; and ice cream, 2.77 gallons. In 1928 our net imports of butter and cheese were 761,279 pounds of butter and 77,833,325 pounds of cheese. In the same year our exports of sweetened and unsweetened condensed milk exceeded our imports by 112,804,852 pounds, and our exports of dried milk exceeded our imports by 1,156,626 pounds. For the past few years the United States has been on an import basis.

III. PRODUCTION OF MILK

The amount of milk estimated to have been produced in the United States in 1926 was 120,766,000,000 pounds. Our principal milk-producing area extends from the New England and North Atlantic States in the East to Minnesota and the northern States of the Mississippi Valley on the west. Also in sections of the States of California, Oregon, and Washington dairying is carried on extensively.

Formerly intensive dairying was practiced only close to large centers of population, which required large quantities of milk for consumption as fluid milk. However, the geographic trend of dairying in the last few years has been toward the better soils of the Corn Belt and extending northwest into Wisconsin, Minnesota, and the Dakotas.

Conditions which are favorable to dairying are: Climate and soil suitable for growing corn for silage and legumes, especially alfalfa; fields of a size and contour suitable for power farming; farms close enough to centers of population so that they will be convenient to good markets; low priced, efficient labor, and good pastures with plenty of rainfall.

The United States Department of Agriculture and the various State experiment stations have carried on enormous amounts of research work to reduce the cost of production through the breeding, selection, management, and feeding of dairy cattle. These studies have shown that there is a direct relation between the production per cow and income, and that the dairyman who uses modern methods in the elimination of the low-producing cows in his herd has the highest income.

Dairy herd improvement associations provide a very effective means for discovering low-producing cows. On January 1, 1930, there were 1,143 dairy herd improvement associations in the United States. In these associations there were 507,549 cows on test. This number of cows was 2.3 per cent of the total of 22,499,000 cows in the United States, as estimated by the United States Bureau of Agricultural Economics. In 1928 the average annual production of the cows in these associations was 7,464 pounds of milk, or 295 pounds of butterfat, which was 60 per cent greater than the average production for all the milk cows in the United States.

The rapid growth of dairying in the Corn Belt in the last few years promises to continue. There are good reasons why dairying should increase in this section. Corn and alfalfa grow there very well. Sweetclover fits into the cropping system. Power farming is entirely practical for raising crops. The region is far enough away from the industrial centers for labor to be obtained economically, yet close enough to provide markets for milk or its products.

Grain farms, especially the wheat-growing sections in the Red River Valley, are beginning to show signs of soil exhaustion. This condition is necessitating a change in the cropping system and the inclusion of the growing of cattle, either beef or dairy.

For many years State and Federal agencies have been making studies and investigations for the purpose of increasing efficiency in the production of milk, and there is no question but that milk can be produced at a lower cost by using the best-known methods. This would mean that fewer cows would be required for producing the Nation's milk supply.

IV. MARKETING

The majority of the market milk produced in the United States is sold in individual transactions between the producer and the processor or distributor. A portion is sold and delivered by the producer direct to the consumer. The rest is sold by what are known as fluid-milk marketing associations, which are cooperative organizations of producers. In 1928 these associations marketed about two-fifths of all the milk sold in the United States, a fraction valued at more than \$325,000,000.

The period of greatest growth of these associations began during the World War. In general, the associations are of two types, depending on the kind of service rendered. One is the bargaining type and the other is the operating or marketing type. The operating or marketing association has in addition to the bargaining function, facilities for the physical handling of the milk. Some associations of the operating type have receiving stations in the country, where the milk is received, cooled, and shipped to dealers in the cities. Such stations may have facilities for manufacturing surplus milk into various dairy products.

Adjusting the production of milk to the consumptive demands is one of the most difficult problems connected with the marketing of milk, and various buying plans have been worked out for the purpose of equalizing production throughout the year as far as is possible. Under the so-called "basic surplus" plan each producer is assigned a definite volume of production, and for all milk produced in excess of this basic volume he receives a surplus or lower price. Each producer's basic quantity is usually determined by his average production during the previous October, November, and December, the period of the year when the supply and demand for market milk most nearly balances. If a producer produces say an average of 3,000 pounds for these three months, then 3,000 pounds represents the base for this producer for the year, and he will receive market milk prices for milk delivered each month up to his basic 3,000 pounds. For any milk over 3,000 pounds, he will receive a less price according to a

schedule worked out in the plan. Modifications of the plan to suit local conditions have been adopted by associations in different States.

The "contract plan" is a modification of the basic surplus plan designed to equalize the supply of milk throughout the year. Under this plan as used by the Connecticut Milk Producers' Association, the producer upon signing the contract previous to March 31 of any year states the quantity of milk he proposes to deliver daily for the next 12 months, beginning April 1. The producer is then penalized for production in excess of the amount specified or for shipping a less amount than that specified. The money collected from penalties does not go to the distributor but is pooled by the producers and prorated among producers in such a way that it is equivalent to a bonus received by the producers having even production.

In some cities, the producer or association receives one price for milk used as fluid milk and a lower price for any milk which has to be made up into by-products. Many cities and sections of the country consider the butterfat content in paying for fluid milk. Milk testing 3.5 or 4.0 per cent of butterfat may be taken as the base, with a differential used for figuring premiums to be paid for milk testing higher than the base or for cuts in the price for milk testing below the base. Also, in some sections premiums are paid to producers for maintaining certain conditions of sanitation in relation to their milk production.

V. TRANSPORTATION, PROCESSING, AND DELIVERY

The rapid growth of cities and the increases in the per capita consumption of milk have had the effect of enlarging the milk sheds from which many of the cities receive their milk. Improvement in motor trucks and roads and the introduction of tank trucks and tank cars, with modern means of insulation and refrigeration, have made it possible to extend the milk-producing areas.

The adoption of tank trucks and tank cars has stimulated the establishment of country receiving stations. In April, 1928, more than 75 per cent of Chicago's supply of milk was being shipped to that city by tank truck or tank car.

Tank trucks are used for routes covering 120 to 150 miles for the round trip, and tank cars make it entirely practical to extend a city's milk-shed beyond the 300 to 500-mile zone.

In Chicago, in 1925-26, it took approximately 51 cents of the consumer's dollar to pay for hauling the milk into the city, processing, bottling, and delivering it to the consumer. Forty-five cents of the consumer's dollar was received by the milk producer, and the balance, less than 4 cents, was net profit to the final distributor. Data tabulated by the Bureau of Dairy Industry of the United States Department of Agriculture in 1928 showed that the f. o. b. price of milk in different cities ranged from 37.0 per cent of the retail price of milk (in Denver, Colo.), to 64.1 per cent (in Richmond, Va.).

A study made in Chicago in 1926 showed that the price received from the ultimate consumer for a quart of market milk averaged 12.9 cents. The farmer received 5.3 cents for this milk, leaving a gross margin of 7.5 cents per quart. Purchasing, receiving, and processing cost 2.2 cents per quart. It took 4.6 cents to sell and deliver the quart. General and administrative expenses amounted to 0.3 cent, and net income was not quite 0.5 cent per quart.

The grocery or general store has a limited function in supplying milk in most places. "Very few stores," according to Kelly and Clement, "will care to provide refrigeration and attend to the selling of the milk for less than 2 cents per quart. Therefore, the price that the consumer must pay at the store is usually as high as that delivered at his own door, and in special instances the price at the store is higher, even though the consumer comes to the store for the milk."

VI. SANITARY QUALITY OF MILK AND CREAM

The dairy industry could add millions of dollars to its annual receipts if only milk of the finest quality was produced. Ten or fifteen years ago this situation was accepted as inevitable, and it was difficult in some places to deliver sweet milk of good flavor to the market. As a result of years of constant work by agricultural and public health agencies, our farms and milk plants and their products are on a much higher plane of sanitation. This improvement has been brought about in a number of ways. For example, the United States Department of Agriculture has for more than 30 years been studying the question of dairy sanitation and methods of supplying the consumer with adequate and wholesome milk supplies. The State colleges of agriculture and agricultural experiment stations, State departments of agriculture, and other agencies, have been working effectively along this same line.

The California State Department of Agriculture has done one of the most effective pieces of dairy sanitation work. The State department of agriculture, because of its close touch with producers and manufacturers of dairy products, has an unusual opportunity to study methods of milk production and to devise practical and efficient methods for sanitary control. California is cited because it provides one of the best working examples of an economical State-wide program for the protection of the public health, improvement of the product, and the instruction of the dairy industry in the best known methods for the economical and sanitary production and processing of dairy products.

The United States Department of Agriculture and the various State agricultural colleges have the research and extension facilities and personnel not only to study questions of quality improvement, but to disseminate information on the subject among producers and

manufacturers of the Nation. The department has outlined a program of quality improvement which can be, and is being, promoted by the State extension services in their work with adults and the boys and girls of the 4-H clubs. A number of States have already become interested in this program and are taking active steps to put it into effect. In 1929, through the cooperative extension work and the general distribution of information in printed and other forms, 78,552 farms improved their practice in the production and care of milk to make their product more sanitary. A number of other agricultural agencies and trade organizations have contributed to the raising of the general level of the quality of milk.

The modern trend of the dairy industry, in its steps to reduce losses through improperly produced milk and cream and to insure the consumer of an abundant supply of wholesome milk, is illustrated by some of the work that is being done by trade organizations. In 1929 seven dairy organizations which were conducting quality-control work on market milk and cream were studied by the United States Bureau of Dairy Industry. Five of these were producers' organizations and the other two were dairy councils. This quality-control work included routine inspection of dairy farms and instruction of dairymen in methods of producing milk of better quality. It also involved laboratory tests to determine the quality of the milk delivered by individual farmers. In one of the producers' associations 69 field men were employed for farm and country work, and in addition to this the organization employed 7 veterinarians and 16 laboratory workers. The cost of the quality-control work done by dairy organizations ranges from \$6,000 to more than \$250,000 per year per organization. Premiums ranging from 5 cents to 58 cents per 100 pounds have been paid for high-quality milk, and deductions ranging from 15 cents to 25 cents per 100 pounds have been made for lower quality.

Aside from agricultural agencies health organizations, both official and semiofficial, have done a vast amount of work in improving the milk supplies. Among the bodies which have worked on milk control are the United States Public Health Service; State, city, and county boards of health; the International Association of Dairy and Milk Inspectors; the American Public Health Association; the American Child Health Association; American Association of Medical Milk Commissions; and other similar agencies.

Reports gathered from city health departments in 1929 give tangible evidence of the improvement of the milk supplies.

The eradication program relative to bovine tuberculosis has a tremendous bearing on the economy of milk production and livestock raising as well as upon the public health. Systematic work along this line began only about 10 years ago, and far-reaching results have already been obtained. Three States—namely, Michigan, Maine,

and North Carolina—have been declared free areas by virtue of the fact that this disease has been practically eliminated from these areas under State and Federal supervision.

The abortion disease of cattle is the cause of great losses to the dairy industry, and it may have a significance in relation to the public health where raw milk is consumed. Abortion in dairy cattle, as well as in other livestock, has been found to be closely associated with undulant fever in man. Elimination of the cows infected with this disease from the herd, through the test that has been worked out for this purpose, will remove this source of danger to the human family. It has been found that pasteurization will safeguard the milk supply from this disease. Legislation has been set up in 12 of the 48 States in efforts to control this disease in dairy cattle.

STATEMENTS AND RECOMMENDATIONS

1. The consumption of fluid milk in the United States is too low for proper and economical human nutrition. We are far below the optimum daily consumption of milk for the normal child. Every educational facility should be used to acquaint both adults and children with the desirability of consuming milk and dairy products in adequate amounts. Health agencies both official and voluntary, should more actively encourage greater use of high-quality milk as a nutritional and health protective program.

2. The present production of milk in the United States is ample to provide sufficiently for the optimum consumption of fluid milk on the basis of the present population. A large proportion of our properly supervised market-milk supply is of such quality that it can be recommended for human consumption.

3. Many dairy products and by-products, other than milk, are available in quantity and quality suitable for wider inclusion in the American diet. Some of the whole-milk products may be used in place of whole milk under certain conditions.

4. The prices of milk and other dairy products are reasonable, considering their exceptional food value and cost of production in comparison with other foodstuffs which make comparable demands as to care, expense, and service in production and merchandising. In order that milk of high quality shall be available on an equitable basis to consumers generally the price of milk to the producer should be based, in a general way, upon the market price of butterfat, plus a sufficient additional amount to cover the additional costs necessary to produce and deliver milk that is high in quality.

5. Educational programs for raising the general level of quality of milk should be more extensively carried on through agricultural agencies thoroughly conversant with proper dairy practice and by the dairy industry itself. Such agencies are in intimate contact with every branch of the dairy industry. Unbalanced programs of dairy

sanitation lead to undue costs in producing and processing milk. On the other hand, practical quality improvement work not only serves to protect health and welfare, but is a direct aid to the dairy industry through the elimination of financial losses and the widening of markets.

6. The future fluid-milk supply may come from greater distances from the point of consumption. Cheaper land, labor, and foods are usually available in sections away from large industrial centers. Local production should be encouraged to meet local demands; but where this is impossible, arrangements should be made for the proper shipment of high-quality milk and cream from a distance. To meet such a need, dairy manufacturing plants in strategic locations should be equipped to receive, cool, and ship milk and cream in a sanitary manner. Intensive sanitation work should be done with farmers delivering milk to processing plants. In this way, not only will the total supply of all dairy products be improved in quality, but larger quantities of milk of suitable quality will be available for shipment to city markets. The extension of country milk-receiving stations where milk is received, cooled, and shipped will expand milk-sheds, especially in the South and other sections where cooling on the farm is difficult to accomplish.

7. Every aid should be given to stimulate more economical and efficient milk production. This should expand research and extension along such lines as breeding, feeding, and management of dairy cattle; disease, parasite, and insect control in dairy herds; improvement of pastures and the raising, harvesting, and storing of crops, notably alfalfa, which are especially adapted to dairy farming.

8. Greater attention should be given to methods of transportation, terminal facilities, and warehousing of dairy products for the elimination of waste and improvement of quality.

9. It is essential that milk production be better adjusted to consumption throughout the year, to prevent the seasonal surpluses which tend to disorganize markets. Extension of a rational surplus plan of milk buying will do much to remedy this condition.

10. There should be a more widespread and uniform system of buying milk on the basis of butterfat content and sanitary quality. Payment for additional butterfat over the basic varies from 30 cents to \$1.09 per pound in market-milk centers. In many cases at present the differential is far too low to warrant the additional cost of producing additional fat, while in others the financial penalty is too severe for milk lower in fat. Clean milk of low bacterial count costs more to produce and is of greater value to plant operators and consumers. As yet the additional payment for high quality is not widely made. An extension of this system will result in rapid improvement of quality generally.

11. It is possible to reduce the cost of processing, bottling, and delivering milk. Studies have shown that many milk plants can

make decided improvement in plant arrangement for efficiency, better utilization of labor, and the curtailment of material losses, such as those represented by spilled or wasted milk, broken milk bottles, poorly utilized steam, power, and refrigeration.

12. The production and processing of milk usually are more sanitary and more economical in those plants which handle sufficient volumes of milk to enable them to have ample equipment of the best machinery and skilled technicians and labor, and use the best methods, and operate at or near capacity. Furthermore, the centralization of the milk industry makes it easier to carry on the work of inspection and control.

O. E. REED, *Chairman.*

C. E. GRAY.

FREDERIC HOWE.

General Conclusions and Recommendations

Among certain peoples, infants and children have been reared without a milk supply after the weaning period. Many such children tend to suffer for a few years because the adult type of diet is not suitable for the young child. Prolonged breast feeding is the custom in such places and there is a far greater health hazard to the child after weaning if cow's milk is not provided. In a country such as the United States, where it is economically and agriculturally desirable to produce milk in abundance, it is a sound policy from the physiological point of view to include a liberal amount of milk in every child's diet. Therefore, an adequate supply of safe, good-quality milk should be available for all children. The best information available indicates that approximately a quart of milk, or its equivalent in other dairy products, is desirable daily for the average growing child; but the average child receives considerably less than this amount.

Further research should be conducted to add to the existing knowledge of the nutritional value of milk and milk products. A number of researches in this field are suggested in the report of the subcommittee on the nutritional aspects of milk. Adequate facilities should be provided for researches.

There is ample evidence that milk is an important factor in the transmission of certain communicable diseases unless it is properly produced, processed, and distributed. A study of the reported outbreaks of communicable diseases attributable to milk in the United States indicates that the largest number occur in the smaller communities in many of which the milk supply is not properly supervised and in which the percentage of milk pasteurized is small.

From a study of these outbreaks attributed to dairy products, it appears that improperly supervised fluid milk has been the most frequent offender in the transmission of disease, and that ice cream,

cheese, and butter are minor offenders. The latter will, in the future, probably become even less significant in this respect. No evidences were found to indicate that milk powder, condensed milk, or evaporated milk are significant communicable disease vectors.

There is need for further improvement in the public health and quality supervision of the milk supply of this country.

The supervision of milk, cream, and other dairy products is of vital public health concern and economic importance, and should receive the coordinated attention of all State and local agencies, including public health authorities, agricultural departments, and agricultural, educational, and extension organizations within the State or community.

Laws or regulations for the supervision of milk supplies, whether local, State, or Federal, should incorporate in so far as practicable uniform requirements at least the equivalent of those contained in a milk ordinance to be recommended by the United States Public Health Service and the Bureau of Dairy Industry of the United States Department of Agriculture. It is fundamental that all milk supplies should be surveyed and rated as frequently as practicable. Inasmuch as the laws and regulations relating to the public-health supervision of milk supplies deal only with measures which are designed primarily to protect the public health, they should, when practicable, be made the function of health authorities, local, State, and Federal. The public-health supervision of municipal milk supplies should obviously be the function of governmental departments primarily dedicated to the public health point of view and technically trained in the recognition of all public health aspects of the problem.

In the absence of local milk control, the State must assume this responsibility.

Health authorities should recommend to American milk consumers that the general market milk be pasteurized before it is consumed, either in a properly supervised pasteurization plant or at home.

Milk should be bought and sold on a quality basis in order to reward and stimulate good quality.

In order that the supervision of milk and milk products may become general, and in order to educate the people as to the importance of adequate milk consumption, the Federal Government should prepare and institute a coordinated program of education and supervision, and the States which have not already done so are urged to develop and put into operation a program coordinated with the Federal program.

